

**GEOPHYSICAL REPORT**  
**511/527 West Simpson Street**  
**Flint Oil Property**

**Electromagnetic Survey**  
**Tucson, Arizona**

**for**



**City of Tucson**  
**Environmental Services**

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Zonge Job# 0816

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**PROJECT SUMMARY**

On February 7, 2008, Zonge Engineering & Research Organization, Inc. (Zonge) conducted a geophysical survey on the Flint Oil Property at 511 – 527 West Simpson Street in Tucson, Arizona for the City of Tucson Environmental Services at the request of Pat Hartshorne of SCS Engineering. The general location of the project site is shown in Figure 1. The Zonge geophysical crew, with Tim Nordstrom as crew chief, surveyed the area using a Geonics EM61-MarkII electromagnetic (EM) instrument. The project objective was to locate and delineate any geophysical anomalies which would be indicative of underground storage tanks (USTs) on the site.

The EM data were acquired with a nominal station spacing of approximately 0.5 ft along lines, and a line spacing of 2-3 feet effectively creating a dense grid of stations covering the survey area. The survey was completed in one day with no delays. The crew also recorded location information using their GPS for the SCS soil sample locations. A list of these coordinates can be found on Figure 2 and Appendix A.

There are several linear anomalies that are evident in the data that are most likely the result of buried utilities. Five small isolated anomalies are also present but none of these are interpreted to be large enough or strong enough to represent a buried UST. These anomalies are shown on Figure 3.



*Figure 1: General location of the Flint Oil Property survey site.*

## **FIELD METHOD AND EQUIPMENT**

### Method Overview

Electromagnetic (EM) techniques are based upon the phenomenon of electromagnetic induction (as opposed to 'electrical' methods that are grounded, or galvanic methods). In short, EM induction occurs when time-varying electrical currents generate magnetic fields, which in turn induce secondary currents in subsurface conductive bodies. These secondary currents or magnetic fields, which are sensed with loops of wire in the instrument, can indicate very conductive ground and buried metallic objects including buried utilities, USTs, and other buried metallic sources.

### Survey Equipment

An EM61 Mark II system was used for the Flint Oil UST survey. The EM61 system is manufactured by Geonics Limited, of Mississauga, Canada. The system is a modified transient electromagnetic (TEM) survey technique. This type of survey involves transmitting a 25% duty cycle, time domain, square-wave signal into an ungrounded loop of wire. This square wave signal alternates between positive and zero voltages, at a frequency of 75 Hz. The measurements are made when the transmitter is off, i.e., when the transmitter voltage is zero. During these times, decaying magnetic fields from subsurface conductors can be measured. In the EM61 system, these magnetic fields are detected in up to two horizontal ungrounded loops of wire. The measurements are made at a fixed time, or time-gate, after the background earth response has decayed, but while decaying secondary fields from strong conductors, such as metallic objects, are still detectable. The EM61 is relatively insensitive to variations in ground resistivities, and normally responds only to metallic objects. EM61 data can not normally be used to discriminate metal types (copper, steel, etc.), thus interpretation is usually based on the size, shape, and strength of anomalous features.

### EM61 Survey Parameters

The EM-61 instrument itself is mounted on a mobile hand-cart and consists of one transmitter loop and two receiver loops mounted on the coil assembly. The rectangular loop dimensions for the system for this survey were 1 meter (cross-line dimension) by 0.5 meters (in-line dimension). The system was configured to measure 4 time gates from the bottom coil assembly. The Zonge field

crew operating the EM61 instrument traversed the survey area site at a slow walking pace with a ground-sample, or station, interval 0.5 ft. Line spacing was 2-3 feet.

A Trimble Asset Surveyor GPS system will be mounted on the receiver cart to provide sub-meter positioning of the data.

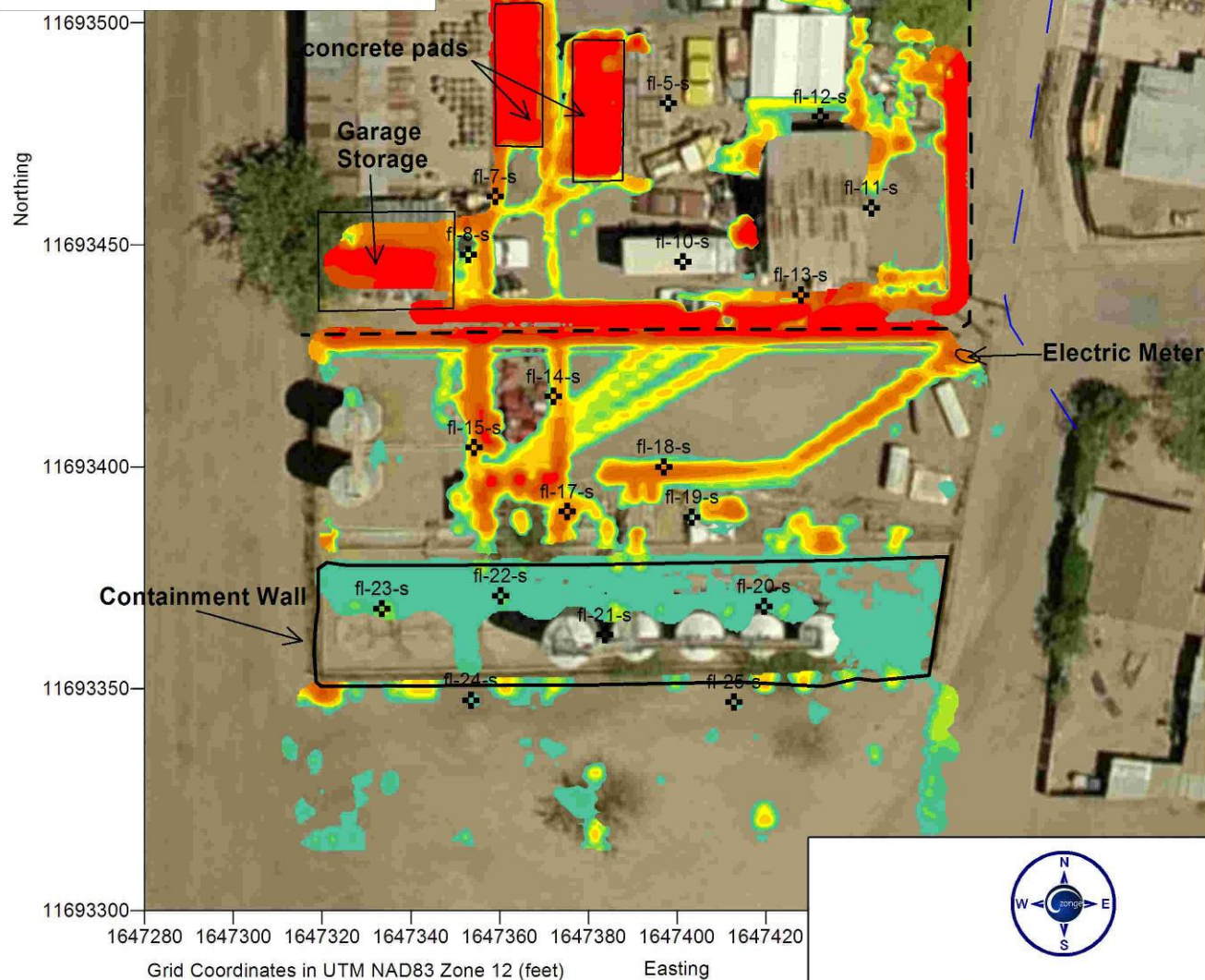
## **DATA PRESENTATION**

The EM data are presented as plan view maps of the vertical electromagnetic field component measured by the EM61 instrument from window 4 of the survey area. Figure 2 and 3 are color-contour maps of signal strength with Figure 2 showing the location of the soil samples and anomalous reading (with background removed) and Figure 3 displaying data with background values as well as labeled anomalies. Here, background noise (indicating no anomalous features) is plotted in “cool” colors (blue, green), weak anomalies are shown in yellow, and strong anomalies are shown in warm colors (orange, red). Cultural features (fences, power lines, concrete pads etc.) as well as building were surveyed by the crew and placed on the final map. The aerial photography used as the base map for the survey was acquired from Pictometry. The coordinates surveyed by the crew had to be shifted by a few feet to overlay on top of the map properly.



Figure 2

Soil Sample	Easting	Northing
fl-2-s	1647358	11693555
fl-5-s	1647398	11693482
fl-7-s	1647359	11693461
fl-8-s	1647353	11693448
fl-10-s	1647401	11693446
fl-11-s	1647444	11693458
fl-12-s	1647432	11693479
fl-13-s	1647428	11693439
fl-14-s	1647372	11693416
fl-15-s	1647354	11693404
fl-17-s	1647375	11693390
fl-18-s	1647397	11693400
fl-19-s	1647403	11693389
fl-20-s	1647420	11693369
fl-21-s	1647384	11693362
fl-22-s	1647360	11693371
fl-23-s	1647333	11693368
fl-24-s	1647354	11693347
fl-25-s	1647413	11693347



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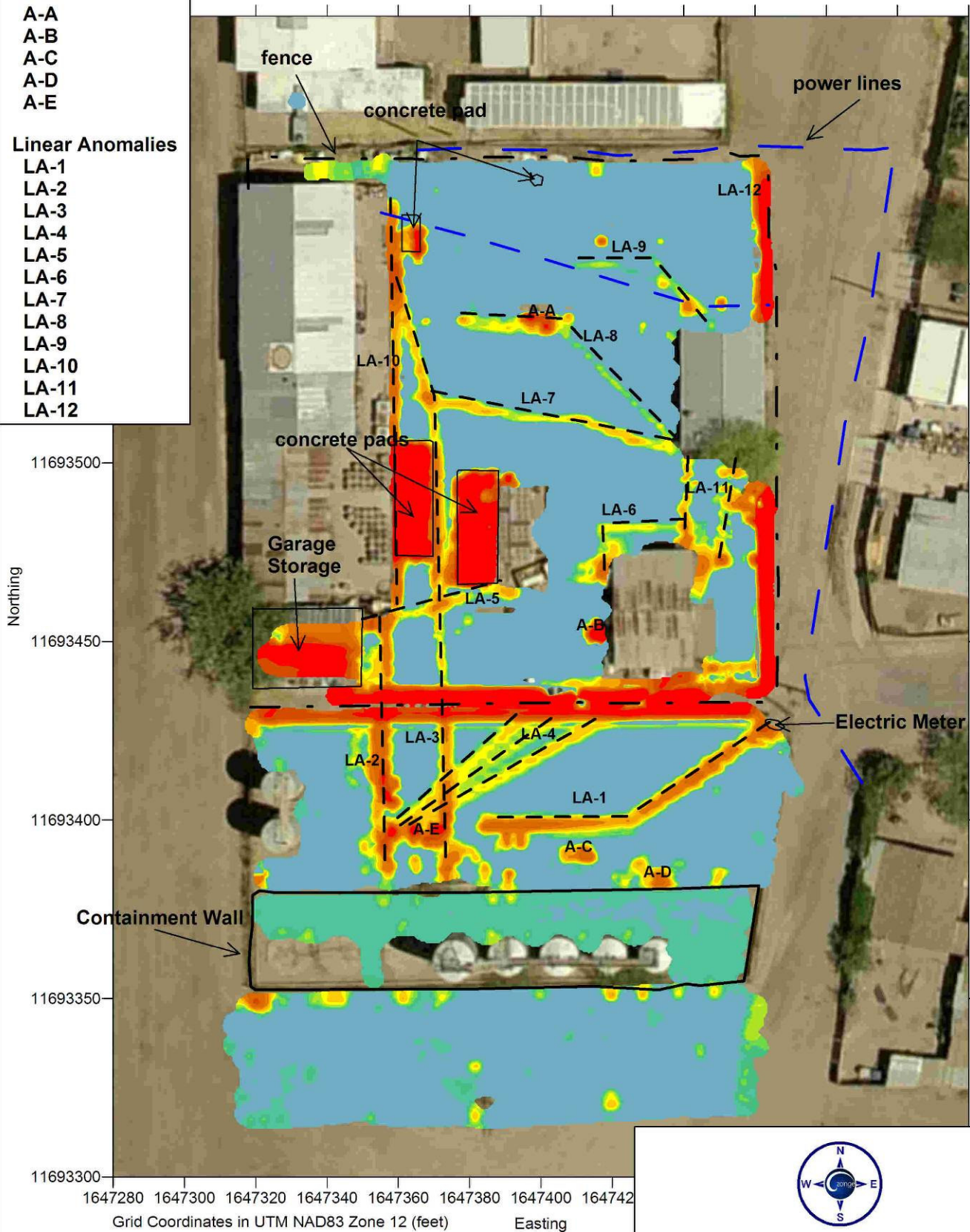
Figure 3

**Anomalies**

A-A  
A-B  
A-C  
A-D  
A-E

**Linear Anomalies**

LA-1  
LA-2  
LA-3  
LA-4  
LA-5  
LA-6  
LA-7  
LA-8  
LA-9  
LA-10  
LA-11  
LA-12



0ft. 25ft. 50ft. 75ft. 100ft.



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## SURVEY RESULTS

Several small anomalies and linear anomalies are noted in the data (Figure 3). The coordinates for the five small anomalies are listed in table 1 in UTM NAD83 Zone 12 (feet). Anomalies A-A and A-B are located in the northern half of the project area. A-A lies within a moderate linear anomaly (LA-8) and is located in the vicinity of the “*possible former dispenser area*” noted on the map provided by SCS Engineering. The elevated signal is no more than 10 feet in length (EW) and 5 feet in width (NS). This anomaly is not large enough to represent a large buried UST, but may be part of the plumbing associated with the tanks. Anomaly A-B is located on the western edge of the vehicle shop and does not extend more than 5 feet in any direction. A-B could possibly be an old heating tank next to the building.

Anomalies A-C, A-D, and A-E all lie north of the containment wall around the ASTs and south of the east-west fence crossing the survey area. Neither A-C nor A-D is associated with a linear anomaly. Both are less than 10 ft (EW) by 5 ft (NS). A-E is located south of the intersection of several linear anomalies (LA-2, LA-3, and LA-4) and in the vicinity of the “*shed with hose storage*” noted on the map provided by SCS Engineering, though this feature may be slightly to the east of the shed. Again, none of these anomalies are large enough to be the result of a large buried UST.

Anomaly	Easting	Northing
A-A	1647401	11693539
A-B	1647416	11693452
A-C	1647412	11693390
A-D	1647433	11693383
A-E	1647371	11693397

**Table 1:** Coordinates for anomalies labeled on Figure 3 (UTM NAD 83 feet).

Twelve linear anomalies are evident in the EM-61 data. The largest anomaly trending east-west through the survey area is caused by the fence and is not labeled. The crew collected data along the fence on the north and south, thus exaggerating the anomaly. Linear anomalies LA-1, LA-2, and LA-3 all appear to possibly be caused by buried utilities, possibly pipes. LA-1 begins on the



eastern driveway near the electric meter noted by the field crew and ends near the location of the “fill ports” noted on the SCS map. LA-2 appears to line up with the “AST piping” from the SCS map. LA-3 is located to the east of LA-2 and extends from anomaly A-E to the north, between the concrete pads, and terminates near the elevated concrete platform.

LA-4 radiates from the southern end of LA-2 and splits into three low resistive anomalies that appear to terminate at the anomaly caused by the fence. This feature is much weaker than the linear anomalies discussed above and may be caused by buried wires.

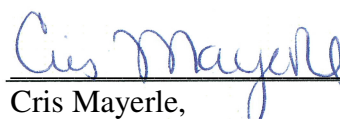
Linear anomalies LA-5, LA-6, LA-7, LA-8, LA-9, and LA-10 all begin and or end at the location of a building on the property. LA-5 extends from the “Garage Storage area” (SCS map) to a concrete pad. LA-6 and LA-7 both run from the Vehicle Shop with LA-7 terminating at the Office. LA-7 and LA-8 both begin the southwestern corner of the Office building with LA-7 running into LA-3 and LA-8 crosses the local anomaly A-A. LA-9 is a very weak linear feature north of the Office building. All these features are most likely due to buried utilities associated with the buildings on the site.

LA-10 runs along the eastern edge of the platform around the warehouse. LA-12 extends along the eastern fence line. Both of these anomalies should be considered the result of known cultural features.

No anomalies were detected in the project area that could represent large USTs. Several small anomalies are evident, but none larger than 10’ by 5’. Numerous linear anomalies are present in the data that are most likely caused by buried utilities (pipes and/or power lines) associated with the structures that either are still present or were noted on the map provided by SCS Engineers.

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Norman R. Carlson,  
Chief Geophysicist



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Cris Mayerle,  
Geophysicist

## Appendix A

### Soil Sample Locations

All coordinates in UTM NAD83 Zone 12 (feet.)

Sample	Easting	Northing
fl-2-s	1647358	11693555
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